UNITED NATIONS UNIVERSITY
UNU-WIDER
World Institute for Development Economics Research

Research Paper No. 2005/63

The Microeconomics of Inequality, Poverty and Market Liberalizing Reforms

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November 2005

Abstract

This paper illustrates how the use of microeconometric techniques can be used to uncover the micro dynamics behind macro shocks. Using Mexican micro data we find out that—controlling for everything else—between 1994 and 1998 returns to personal characteristics in the tradable sector increased particularly those of skilled labourers. By the year 2000 the positive shock upon the tradeable sector vanishes with returns to personal characteristics converging to the levels observed in the non-tradable sector. We use our model's results to simulate a scenario where the Mexican economy experienced

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Keywords: inequality, poverty, microsimulation, NAFTA, Mexico
JEL classification: C3, D1, F16, O24

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This study has been prepared within the 2005 UNU-WIDER Internship Programme and is published in the project on New Directions in Development Economics.

UNU-WIDER acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Norway (Royal Ministry of Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida), and the United Kingdom (Department for International Development).

ISSN 1810-2611 ISBN 92-9190-747-2 (internet version)

the negative shock of the peso crises in the absence of trade liberalization (NAFTA) and find out that under such a scenario the poverty headcount ratio would have increased more than 2 percentage points above the one observed in 1996. The simulated second-order effect of these changes shows that the skill mixed changed in a way that favoured relatively skilled men and relatively unskilled women. These changes in labour participation and occupation had an overall positive income effect though adverse in distributive terms.

Acknowledgements

I am grateful to the continuous guidance of Ajit Singh. Useful comments by Tony Addison, Amelia Santos-Paulino, Anthony Shorrocks, and participants at the UNU-WIDER seminar in Helsinki (2005), and the Fourth EUDN Workshop on Development Research in Bonn (2004), are also acknowledged. The usual disclaimer applies.

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Camera-ready typescript prepared by Lorraine Telfer-Taivainen at UNU-WIDER

1 Introduction

The welfare effects of market oriented reforms in developing countries remains a highly polemical topic. Although market liberalizing reforms include a wide range of economic policies, the great bulk of studies on the subject have concentrated on the welfare effects brought about by trade policy. This is not surprising given the advantage of having a well-established theoretical framework linking trade policy with household welfare.[1] Moreover most of the market-oriented reforms have trade liberalization at the core of their economic policy. The most influential empirical papers linking trade and welfare have concentrated on the impact that trade liberalization had upon wage differentials (skilled vs. unskilled labourers) during the 1980s and early 1990s (see Revenga 1995; Feenstra and Hanson 1997; Harrison and Hanson 1999). The main result found by those studies is that wage differentials were positively related with trade reforms, explained, possibly, by the world wide skill biased technological change taking place during that time. Although wages are an important part of household welfare, the approach undertaken in the afore mentioned papers, fails to take other important income components into account. More importantly, the effects of a particular policy (e.g. reduction of trade tariffs) are difficult, if not impossible, to identify under the before-and-after approach used by the wage differentials literature.

The present study contributes to the ongoing trade-welfare debate by implementing a novel microeconometric technique using Mexican household survey data for years 1994 to 2000. Through out this period, Mexico undertook important market liberalizing reforms. The combination of the 1994-95 peso crises and the enactment of the North American Free Trade Agreement (NAFTA) transformed the economy into one in which the main source of growth were exports of manufacturing products. This sectoral *redistribution* favouring the manufacturing exporting firms had a profound impact

[1] For discussion on the subject see Dixit (1980) and more recently, McCulloch, Winters and Cirera (2002).

upon household incomes via the changes taking place in the labour market. To understand the ex post welfare effects of Mexico's turn towards a manufacturing-intensive economy is not only useful for future Mexican trade policy design, but it can also be the starting point for ex ante trade policy evaluation in other Latin American countries.

We develop a model that is able to identify all household income components (variables, parameters and unobservables).[2] In order to disentangle the impact that the policy under evaluation has upon a particular household, we estimate the underlying **structural** parameters determining household incomes. The model accounts for earnings and incomes from self-employment activities in Mexican urban areas. The agent's behaviour is taken into account by modelling **structural** labour supply equations linking expected wages and participation in an explicit way. Following this approach we can identify the household income components that had a significant change after the sectoral redistribution took place and their impact upon household and overall welfare. Moreover, the model allows us to undertake counterfactual experiments of nature *what would the distribution have look like had the policy under evaluation been the only change taking place between time t and t'?* To answer this question we microsimulate household incomes imposing the counterfactual to be analyzed.

The paper contributes to the ongoing debate in two areas: (1) By creating an explicit link between expected wages and labour participation, we are able to quantify the second-order effects of changes in personal remunerations brought about by the policy under evaluation. (2) Separating markets between tradable (manufacturing) and non-tradable sectors we create hypothetical income densities capturing the *ceteris paribus* effects of changes taking place in the market for tradable produce. We find out that—controlling for everything else—between 1994 and 1998 returns to personal characteristics in the tradable sector increased with highly skilled workers benefiting

[2]Our model is based on Bourguignon, Fournier and Gurgand (2001).

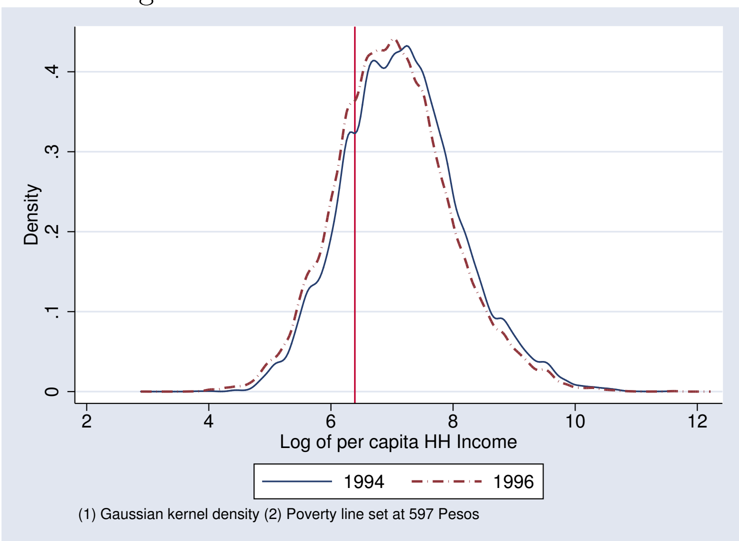
relatively more than their unskilled counterpart. However by the year 2000 the positive shock upon the tradeable sector vanishes with returns to personal characteristics converging to the levels observed in the non-tradable sector. We use our model's results to simulate a scenario where the Mexican economy experienced the negative shock of the peso crises in the absence of trade liberalization (NAFTA) and find out that the headcount poverty ratio would have increased more than 2 percentage points above the observed one in 1996. Inequality, on the contrary, would have been 4 Gini points higher under such a hypothetical scenario. We simulate the change in participation and occupation brought about by the sector redistribution (second-order effects). We find out that, in the case of men, the amount of skilled labourers increase, whereas in the case of women the new entrants were relatively unskilled. This changes in participation and occupation had an overall positive though disequalizing income effect.

This paper is organized in the following way. In the next section we develop the income-generating model used to parameterize household incomes. In that same section the microsimulation principles are described. In Section 3 we show some macroeconomic trends for Mexico during the period 1994-2000 followed by the estimation results in Section 4. The microsimulation analysis to evaluate the welfare impact of the estimated changes is undertaken in Section 5. Finally conclusions can be found in the last section.

2 Parameterizing the density function

A simple way of analyzing the welfare changes occurring between two periods is by plotting a density function of the log of household incomes as in Figure 1. Such a function will incorporate both the average income of the economy and its distribution. In turn, all income distribution functions satisfying some desired properties derive from a more general social welfare function (Jenkins 1991.) For example, a utilitarian social welfare function is the sum of all household welfare. Assuming a decreasing marginal utility of income, we can show that social welfare can be summarized by average real income and its distribution (Sen 1974). In Figure 1 we use the log of real monthly household per capita incomes for Mexico to plot a non-parametric kernel density function for years 1994 and 1996.[3] The kernel distribution contains all the information needed to compute inequality indexes (determined by the shape of the density function) and poverty measures (a function of both the level and shape of the density). Therefore a change in absolute poverty[4] will be the outcome of shifts in the density (growth effect), changes in the shape of it (distribution effect) and a residual (see Datt and Ravallion 1992).

Figure 1: Kernel Income Distributions



Our aim is to find out the underlying **structural** parameters determining real incomes in each and every household in our sample. Once we have done this we can reproduce the shape and level of the density function using the estimated parameters, observable sociodemographic characteristics and unobservable components. Formally, take the shape of the income density

[3]We are implicitly assuming no intra-household economies of scale and no differences between children's and adults' *cost*.

[4]Using the standard FGT indexes often found in the literature.

(distribution),[5] and define an inequality index, I, as a function of a vector of household incomes $\boldsymbol{Y}$ at time t:

$$I_t = I(\boldsymbol{Y}_t); \;\; \boldsymbol{Y}_t = (Y_{1t}, \ldots, Y_{Ht}) \tag{1}$$

The parameters of index $I(\cdot)$ will depend on the social welfare function used, however the underlying parameters (i.e. those determining $\boldsymbol{Y}_t$) will depend on **structural** relationships determined by economic theory. Under certain assumptions, these structural parameters can be estimated empirically. Income of urban household h, Y_h, will be the sum of earnings, income derived from self employment activities and some exogenous income y^o_{ht}. Therefore (we suppressed the time subscripts for simplicity):

$$Y_h = \sum_{i=1}^{m} (\mathbf{w}'_{ih} \cdot \boldsymbol{L}_{ih} + y_{ih} \cdot L^{se}_{ih}) + y^o_h \tag{2}$$

Where $\mathbf{w}_{ih}$ and y_{ih} are the hourly wage and self-employment income of member i in household h respectively; $\boldsymbol{L}_{ih}$ and L^{se}_{ih} are labour supply functions in the earnings and self-employed sectors respectively. The labour supply functions account for both the discrete (participation) and continuous (hours of work) dimensions of it.

The elements present in (2) can be decomposed into different population segments, for example: wages for men vs. women, tradable vs. non-tradable sector, etc. The segmentation use should obey some prior country-specific labour market information and also the nature of the particular policy under evaluation. In our case, our objective is to perform a first approximation of the effects that trade liberalizing reforms had upon each of the elements defining (2). Therefore it seems natural to separate the economy into tradable and non-tradable sectors. The former includes the manufacturing sector whilst

[5] It will become apparent that finding out the household income parameters will allow us to determine also the level of the density which is simply the average household income.

the latter is formed by all other formal sectors and the informal sector in urban areas.[6] To clarify, we define two earning sectors: manufacturing earner and other urban earner, the first of them belonging to the tradable sector and, additionally a self-employed sector—capturing basically informality—is defined as part of the non-tradables. Furthermore, we assume separate labour market equilibriums for men and women.

Equation (2) accounts for all possible income sources, therefore by parameterizing each its elements we can have a better understanding of the microeconomic processes behind changes in overall distribution. The remaining of this section describes the methodology that we will follow to estimate each of the household income components included in (2).

2.1 Wage functions

The term $\sum_{i=1}^{m} \mathbf{w}_{ih} \cdot \boldsymbol{L}_{ih}$ in (2) measures total household earnings. $\mathbf{w}_{ih}$ are hourly wages and $\boldsymbol{L}_{ih}$ is a labour supply function, conditioned on member i being a wage earner: $L_{ih} > 0$. A separate wage function is estimated for each of the 4 labour market segments that have been defined.[7] Following standard human capital literature, wages' reduced form equation is a function of personal characteristics in the following way:

$$w_{is} = \boldsymbol{X}_{is}\boldsymbol{\beta}_s + \varepsilon_{is} \qquad s = (tradeable,\ non-tradeable) \tag{3}$$

Where $\boldsymbol{X}$ is a vector of $(1 \times K)$ dimension and $\boldsymbol{\beta}$ is a $(K \times 1)$ vector $\forall\ s$; K being the different personal characteristics determining wages (including a constant) and $i = 1 \dots N$ number of workers in a particular sector. We allow the residuals to have an expected value different from zero: $E[\varepsilon_{is}] = F(z_i\gamma_s)$ where $F(z_i\gamma_s)$ is a generally defined function capturing individual's

[6]Between 1994 and 2000 manufacturing exports accounted for 95% of total exports.

[7]Manufacturer earner and other earner for men and women.

i probability of choosing sector s. We will come back to this point in section 2.3

2.2 Self-employed incomes

The next step is to model self-employment labour incomes, $y_{ih} \cdot L^{se}_{ih}$, where y_{ih} is also measured in hourly units. In less developed countries, the labour markets for self-employed workers is very much related with informality. Informal markets tend to be incomplete ones and therefore not showing desired equilibrium conditions (i.e. marginal productivity equals real wage). To estimate labour remunerations in this sector we need separability properties and a dataset rich enough to identify the marginal productivity of all factors of production involved in the generation of y_h. Data containing information on the returns to each factor of production involved in self-employment activities is rarely available.

Suppose that the self-employed sector has a labour market close to a competitive one so that labour productivity can be taken as a shadow wage highly correlated with real wages. In such a scenario, returns to $\boldsymbol{X}$ can be said to be exclusive of all other factors of production, furthermore, self-employment activities in the informal sector do not use capital nor land in an intensive way. A formal sector that is semi-competitive and labour-intensive seem to be reasonable assumptions in the case of Mexico. The self-employment market in Mexico is basically formed of independent labourers in the informal sector with few or no capital at all. Studies by Marcouiller, Ruiz and Woodruff (1997) and Maloney (1999) show that the informal sector in urban Mexico is as complete as the formal one representing a desired destination rather than an inferior forced option. Therefore it is possible to identify returns to personal characteristics using the same functional form as the one used for hourly wages:

$$y_i = \boldsymbol{X}_i \boldsymbol{\beta}_{se} + \upsilon_i \tag{4}$$

As in equation 3, $\boldsymbol{X}_i$ is a $(1 \times K)$ vector and $\boldsymbol{\beta}_{se}$ is $(K \times 1)$ a vector. The expected value of the residuals $E[\upsilon]$ are also equal to a function $F(z_i\gamma_{se})$ capturing participation and occupation selection. We now turn to the estimation of the labour supply components of (2).

2.3 Labour supply

The only elements missing from (2) are the labour supply functions in the earnings and self-employment sectors $\boldsymbol{L}_{ih}$ and L^y_{ih}.[8] Estimation of these elements involves modelling a discrete choice equation for participation, together with a continuous one for hours of work. However the data for Mexico shows that, due to institutional rigidities, the distribution of hours worked is highly concentrated around one single point (i.e. 42 hrs.) Therefore we focus in the discrete choice part of the labour supply function, i.e. whether to participate or not and in which sector agents decide to 'sell' their labour endowment.[9]

Assume that participation and occupation decisions of the population within working age are the outcome of a 'utility' maximizing processes involving a set of pair comparisons between expected market wages and a subjective valuation of leisure.[10] Define the indirect 'utility' that individual i gets from choosing option j:

[8] This section borrows heavily from De Hoyos (2005b).

[9] As stated by Heckman: 'Participation (or employment) decisions generally manifest greater responsiveness to wage and income variation than do hours-of-work equations for workers' (Heckman, 1993, pg. 117).

[10] The utility interpretation of equation 5 is not necessary for it to be valid. We could define V_{ij} as a latent function defining the probability of participation without any structural interpretation. Moreover the term 'utility' should be taken with caution here since, most likely, demand-side restrictions are present making the observed labour outcome the result of factors beyond an individual's utility maximizing process.

$$V_{ij} = \delta\hat{w}_{ij} + \boldsymbol{Z}_i\boldsymbol{\gamma}_j + \eta_{ij} \tag{5}$$

Where $\hat{w}_{ij}$ are expected wages or self-employed income—following (3) and (4) respectively; $\boldsymbol{Z}_i$ are household characteristics of individual i.

Expected log wages, $\hat{w}_{ij}$ are determined by the population estimate of $\boldsymbol{X}\hat{\beta}_j$. We are implicity assuming that workers form wage expectations based on their personal observable characteristics ($\boldsymbol{X}$) and their respective market value (β) without accounting for the selectivity 'premium' associated with their participation/occupation decision ($F(z_i\gamma_j)$). This is a necessary assumption to identify all the parameters of the model. Individual's i participation and occupation decisions will follow a utility maximizing criteria: $V_{ij} > \max_{m\neq j}\{V_{im}\} \; \forall \; j$. If unobserved utility components η_{ij}, follow a logistic CDF then the probability of observing agent i choosing occupation s is defined in the following way:

$$Prob(i = s) = \frac{exp(\delta\hat{w}_{ij} + \boldsymbol{Z}_i\boldsymbol{\gamma}_s)}{\sum_{j=1}^{J} exp(\delta\hat{w}_{ij} + \boldsymbol{Z}_i\boldsymbol{\gamma}_j)} \tag{6}$$

Expression (6) has two components, one of them are the expected wages, which vary across outcomes and individuals and are treated as 'attributes' of the occupations. On the other hand $\boldsymbol{Z}_i$ varies across individuals and it is constant across outcomes, i.e. they characteristics attached to the individual. Vector $\boldsymbol{Z}_i$ for men include: household size, other household members' income and its squared form. For women $\boldsymbol{Z}_i$ includes: the number of children in the household, a dummy variable taking the value of one when the head of the household is male and is actively participating in the labour market, other household members' income and its squared form and the variance of all other household members' income.

Agents can choose among the following choices: earner in the manufacturing (tradeable) sector, earner in other formal sectors, self-employed or being inactive.[11] Equation 6 is a multinomial logit where agent i decides where to *sell* her labour endowment (or not to *sell* it at all) based on her expected wages in the different occupations $\hat{w}_{ij}$ and a set of household characteristics $\boldsymbol{Z}_i$. Defining participation and occupation decisions as a function of $\hat{w}_{ij}$ allows us to measure the *second-order effects* of a policy-induced change in expected wages.

This last feature makes our model different from the one developed in Bourguignon, Fournier and Gurgand (2001), additionally our model is consistent between the way it estimates participation and occupation decisions and the way it controls for selectivity in the wage equations. Since labourers observed in each sector are not the outcome of a random process (indeed they are following a utility maximizing criteria), we have to control for selectivity whilst estimating the wage equations' parameters (β). To be consistent between the participation/occupation estimation and the selectivity-adjusted wage functions, following Lee (1983), we correct for selectivity using the conditional probabilities of a multinomial logit. Given the selectivity problem on the one hand and the explicit relationship between expected wages and participation/occupation decisions on the other, the model just outlined involves the simultaneous solution of equations (3) to (6). In this paper we will estimate the model using a computationally simpler two-step procedure as the one developed and discussed in De Hoyos (2005b). Define z_i as a vector containing $\boldsymbol{X}_i$ and $\boldsymbol{Z}_i$. We estimate selectivity-adjusted wages using the multinomial logit conditional probabilities $Pr(z_i\gamma_{j*}) = exp(z_i\gamma_{j*})/\sum_j exp(z_i\gamma_j)$ in the following way:

$$w_{ij*} = \boldsymbol{X}_i\beta_{j*} + \sigma_{j*}\rho_{j*}\left(\frac{\phi(J(z_i\gamma_{j*}))}{Pr(z_i\gamma_{j*})}\right) + \varepsilon_{ij*} \tag{7}$$

Where $\sigma_{j*}\rho_{j*}$ are the parameters capturing selectivity; $J(z_i\gamma_{j*})$ is a transfor-

[11] Notice that the agents do not have the choice of having two occupations, we impose this restriction to simplify the analysis. In Mexico, the primary source of income of all household members accounts for as much as 90 per cent of total household income.

mation of the multinomial logit index, $z_i\gamma_{j*}$, into a standard normal distribution and ϕ is the standard normal density function. Therefore the generally defined selection adjustment component $F(z_i\gamma_s) = \sigma_{j*}\rho_{j*}\left(\frac{\phi(J(z_i\gamma_{j*}))}{Pr(z_i\gamma_{j*})}\right)$. The use of vector $\boldsymbol{X}_i$ in the first-stage multinomial logit proxies for expected wages and therefore the second step wage regressions give us the population unbiased estimators of β_j.

2.4 Microsimulation principles

So far we have shown how to parameterize household incomes in order to identify the elements determining the level and shape of the density function. The estimated parameters of equations (3) to (6) can be used to perform microsimulation analysis to try to isolate the welfare effect of the policy under evaluation.

Let us define $\boldsymbol{\Omega}_t$ as a vector containing all the estimated parameters of equations (3) to (6) for time t. Similarly, define $\boldsymbol{X}_t^*$ as a vector which elements are all the independent variables in the model at time t. Finally a vector of unobservables, $\boldsymbol{\nu}_t$, encloses the set of residuals of all the estimated equations in the model. Therefore, household incomes $\boldsymbol{Y}_t$ will be a function of these three elements (and the exogenous income y_h^0 which for the moment we exclude from the discussion); substituting the elements of $\boldsymbol{Y}_t$ into (1), any income inequality index I—and all other welfare measures—can be define as:

$$I_t = I(\boldsymbol{\Omega}_t, \boldsymbol{X}_t^*, \boldsymbol{\nu}_t) \tag{8}$$

Hence a change in I can be decomposed into changes in the different elements of (8). Once all the elements of (8) are in place, we can create counterfactual experiments of nature: *what would the distribution look like had the elements of, say,* $\boldsymbol{\Omega}_t$ *been the only changed occurring between* t *and* t'*?* For example, let us say that returns to education in the manufacturing sector, $\widehat{\beta}_{m,t}$, changed due to trade liberalization and we will like to know the welfare (distribution/poverty) impact of such a change. We can compute a hypothetical income inequality index where the only element in (8) that is changing is $\hat{\beta}_{m,t}$:

$$I_t^\imath = I(\boldsymbol{\Omega}_t^\imath, \boldsymbol{X}_t^*, \boldsymbol{\nu}_t)$$

Where $\Omega_t^\imath$ contains the 'imputed' value of $\hat{\beta}_{mt}$. $I_t^\imath$ is a *simulated*, unobserved, income inequality index where the income of each household in the database is allowed to change as a result of the change in $\widehat{\beta}_{m,t}$ and all other elements are kept fixed. We will call this a *first-order* income effect. This type of counterfactual exercise is quite powerful, since it enables us to identify not only the qualitative but also the quantitative welfare effect of a change in every element defining the parameterized income equation (8): parameters, covariates and residuals.

Another advantage of our model is its ability to quantify the *second-order* income effects of changes in expected wages. Let us continue with our example of an exogenous increase in $\widehat{\beta}_{m,t}$. This shift will have a direct first-order effect upon household income via the increase in wages of household members working in the manufacturing sector. However an increase in expected wages in the manufacturing sector will also increase the likelihood of observing workers with particular personal and household characteristics selling their labour endowments in that sector. This second order effect is captured by the structural labour participation/occupation function (6).[12] In order to make a clear distinction between the first and second order effects, let us define $\boldsymbol{\Omega}_{w,t}$ as a vector containing the parameters of equations (3) and (4); define $\boldsymbol{\Omega}_{L,t}$ as a vector which elements are the parameters of the participation/occupation equations (6). Therefore $\boldsymbol{\Omega}_t = (\boldsymbol{\Omega}_{w,t}, \boldsymbol{\Omega}_{L,t})$. Changes in $\boldsymbol{\Omega}_{w,t}$ will have a

[12]There are obvious demand-side constraints which are not being taken into account by equation (6). We will address this important issue when we measure the second order income effects of changes in $\hat{\beta}$ in section 5.2.

second-order effect upon participation and/or occupation decisions, nevertheless changes in $\mathbf{\Omega}_{L,t}$ will change labour participation/occupation—and hence household income—without affecting market wages.[13]

We use the outlined microsimulation principles to answer the following question: What is the *ceteris paribus* welfare effect of the observed change in returns to personal characteristics taking place in the tradeable sector ($\mathbf{\Omega}^T_{w,t}$) after the enactment of NAFTA? This simulation will capture the welfare effects—via the labour market—of trade-induced macroeconomic changes taking place between 1994 and 2000.[14]

As pointed out in Winters (2000), any macroeconomic exogenous shock (e.g. trade policy) will have an effect upon the relative prices of the economy. In our model, the single most important set of 'prices' are the wages in the different segments of the labour market. Wages, in turn, are defined as an index of market 'prices' of personal characteristics ($\mathbf{\Omega}_{w,t}$). Therefore, in the short run, changes in $\mathbf{\Omega}_{w,t}$ reflect, mainly, the macro-induced shifts in labour demand. Following this argument, the difference between the observed household income density in a particular year and the simulated one capturing the changes in $\mathbf{\Omega}_{w,t}$, is the welfare effects of macro-induced changes in labour demand. By the same token, the simulated density capturing the welfare effects of changes in 'prices' in the tradable sector ($\mathbf{\Omega}^T_{w,t}$), captures the *isolated* impact of shifts in labour demand in the tradable sector. In particular, the changes in 'prices' in the tradable sector taking place in Mexico between 1994 and 2000 can be attributable to the massive increase in manufacturing exports following NAFTA and the peso devaluation. Our aim is to evaluate the inequality and poverty impact of this change.

[13]In a general equilibrium setting, changes in labour supply function parameters should have an effect upon market wages, however we consider that the model outlined here is complex enough to capture first and second order effects of parametric changes in household income sources.

[14]In a recent literature review revising the trade and poverty linkages by Hertel and Reimer (2004), the authors find that the strongest effect of trade upon poverty works via the labour market and to a lesser extend through consumption effects.

The methodology outlined here shows a way of departing from a macro indicator (say income densities) and decomposed it into its micro components. Once this is done—via microeconometrics—we can 'go back' and reconstruct the macro indicator this time with the micro parameters being identified. This allows us to understand better the micro dynamics behind macro changes.

3 The Mexican economy during the 1990s

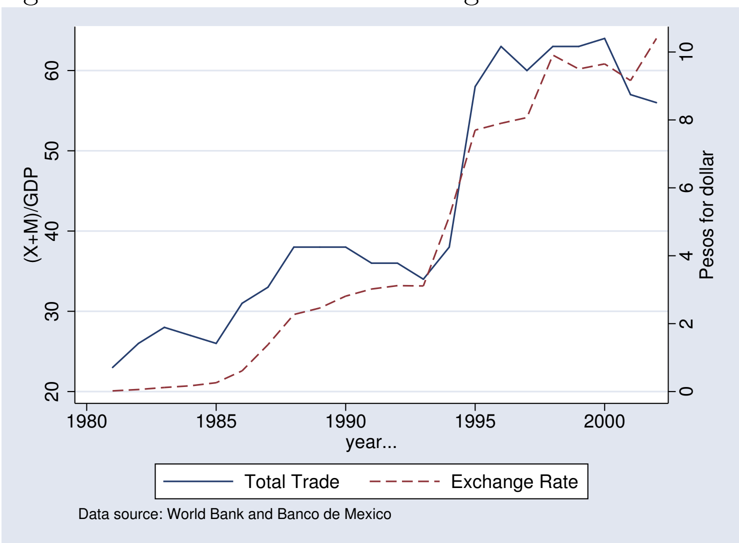
In this section we briefly outline the major changes occurring in the Mexican economy during the second half of the 1990s, a period characterized by a huge devaluation of the Mexican peso in 1994 and the subsequent increase in exports within NAFTA.

During the early 1990s core reform of trade policy focused on the approval of a regional trade agreement with the US and Canada where tariff reduction were scheduled. The agreement, NAFTA, was signed in late 1993 and enacted 1st of January 1994. The following 6 years after the enactment, real exports grew an average rate of 17 per cent with the manufacturing *maquiladora* sector setting the pace at a growing rate of 21 per cent during the period. Given the timing of the two events, i.e. the enactment of NAFTA and the increase in the exporting sector, it is tempting to conclude that the increase in exports was the result of trade policy. However many other macroeconomic changes took place, specially during 1994, year when NAFTA took effect.

Throughout 1994 Mexico experienced substantial political unrest that caused a massive outflow of portfolio investment. Capital outflow combined with a pegged exchange rate created a balance of payment crises. The crises prompted investors to abandon the Mexican market and in December 1994 the peso suffer a devaluation of 83 per cent (see Figure 2). During 1995 real GDP contracted 8 per cent and inflation soared to 43 per cent. Through out the 1996-2000 period the economy experienced an average rate of growth of

6 per cent per year lead, mainly, by exports of manufacturing products. The boost in the exporting sector can be party explained by NAFTA and partly by the large devaluation of the Mexican peso. As it is clear from Figure 2, the performance of openness has been, not surprisingly, closely related with the exchange rate.

Figure 2: Total Trade and Exchange Rate Performance



All these macroeconomic changes had a profound welfare effect as it is shown in table 1.[15] Surprisingly, income distribution in 1996 lorenz-dominates the distribution for 1994, i.e. for any inequality index, income was better distributed after the crisis.[16] However, the negative growth effect of the 1994-95 crises was so large that the poverty headcount ratio increased in more than 10 percentage points. During the recovery period 1996-2000, poverty indicators almost returned to its pre-crises level despite the increase in inequality observed during those years.

[15]For a detailed description of the Mexican household data used in this paper (ENIGH) and the way in which inequality and poverty indexes were constructed see De Hoyos (2005a)

[16]Lopez-Acevedo and Salinas (1999) documented the possible causes behind the reduction in inequality during the 1995 economic crisis.

Table 1: Income Inequality and Poverty Indexes

	1994	1996	1998	2000
Inequality				
Gini	0.534	0.516	0.527	0.528
Theil	0.568	0.537	0.559	0.548
Entropy$_{(\varepsilon=-1)}$	0.751	0.697	0.796	0.782
Poverty Headcount				
Malnutrition	0.174	0.276	0.263	0.200
Capabilities	0.245	0.354	0.329	0.261
Assets	0.482	0.606	0.569	0.494

Source:

(1) Own estimations with data from ENIGH

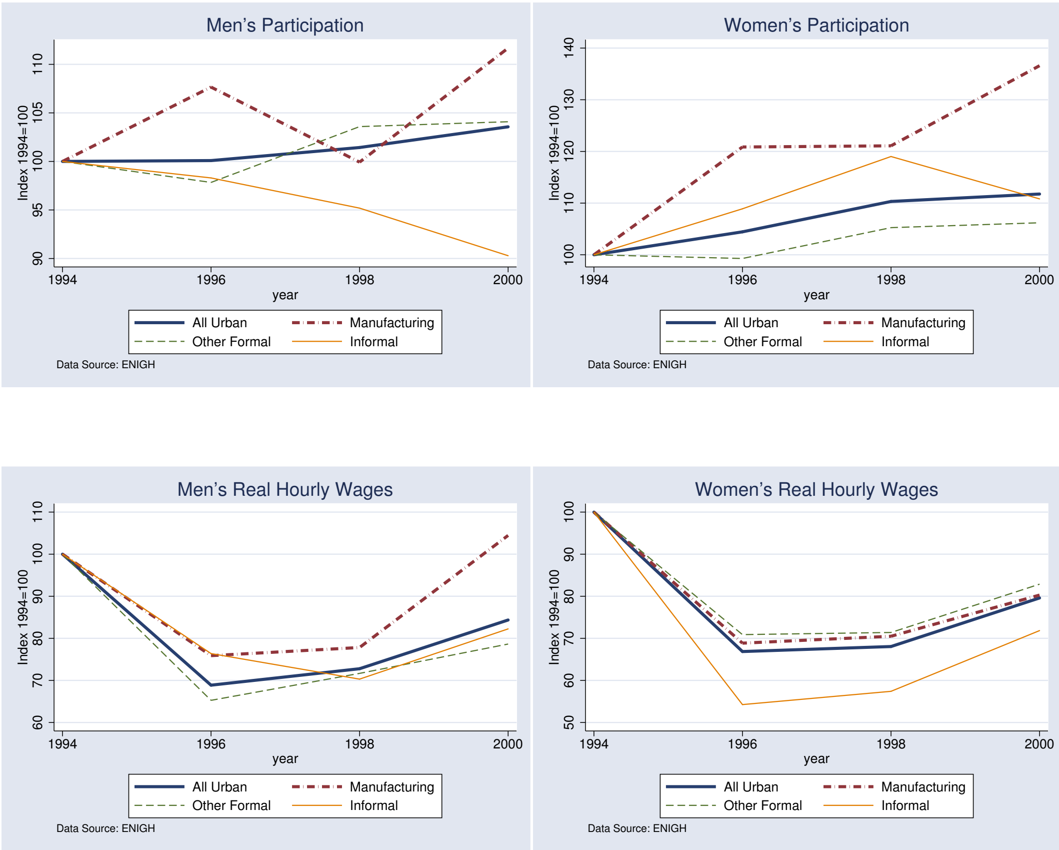
(2) Poverty lines defined by the Mexican Ministry of Social Development

3.1 Labour markets

The huge increase in total trade seen in the post-NAFTA years had a strong effect upon the Mexican labour markets. To summarize its main effects, in Figure 3 we show the annual percentage change of real wages and participation in the different segments of the labour market. As predicted by the theory, women's labour participation reaction to exogenous changes in the economy was much stronger than that for men (see Deaton and Muellbauer 1980.) We can see from the upper part of Figure 3, that during the crisis years (1994-96) male and female participation in the tradable sector increased 7.5 per cent and 20 per cent respectively. In the case of men, this increase contrasts with the observed reduction in participation in the non-tradable sectors; for women, participation also increased in the informal but not in formal non-tradable sectors. Positive changes in participation rates in the tradable sectors are observed through out the period with the exception of the period between 1996 and 1998, when participation in formal non-tradable sectors recovered.

In the lower part of Figure 3 we show the time trends of real 2002 hourly wages. The most important thing to notice is the different pace at which wages for men in the tradable sector recovered from the 1994-95 negative income shock compared with the pace followed by wages in other non-tradable sectors. In the case of women, hourly real wages in the tradeable sector are performing as wages in the rest of the economy, however real earnings (i.e. hourly wages multiplied by hours worked) in the tradable sector recovered faster in the tradable sector than in the non-tradable one. The difference is explained by an increase in average weekly hours worked by women in the tradable sector. Average weekly hours worked by women in the tradable sector passed from 43.95 in 1994, to 45.33 in 1996, and 45.87 in 1998. This evidence is suggesting that while trade shocks affected real hourly wages for men, the effect upon the female labour market had more to do with changes in labour supply (participation as well as hours worked).

Figure 3: Participation and Real Hourly Wages in Urban Areas



Bearing all these macro changes in mind, and being aware of the difficulty of quantifying their isolated effect, in this paper we attempt to understand the linkages between openness—in the form of an increase in manufacturing trade *volumes*—and household incomes. In other words, we want to find out the isolated welfare (inequality and poverty) impact of the documented sectoral redistribution favouring the tradeable sector. Although it is important to distinguish between what is the effect of trade policy (NAFTA) from all other macroeconomic changes affecting the tradable sector performance (in particular the currency devaluation), the documented increase in openness and its possible impact upon income inequality and poverty represents a challenging enough task.[17] Moreover, so long as trade policy (e.g.

[17]In a recent paper Nicita (2004) tries to isolate the welfare effect of trade liberalizing

a reduction in tariffs) is related with higher trade volumes, the qualitative relationship between trade policy and household welfare can be discern from our results.

4 Estimation results

In this section we present the estimation results of the model outlined in Section 2. As we already mentioned, the model is estimated using Mexican household data (ENIGH) for years 1994, 1996, 1998 and 2000. All the statistical analysis undertaken in this paper takes into account ENIGH's survey design (stratification, clustering and expansion factors).[18] Given the great amount of results, instead of describing them in a conventional way, we concentrate in the time patterns shown by our estimated wage and participation equations parameters leaving the detailed results for an Appendix.[19]

In Figure 4 we show the annual change in the different sector's expected log wages for men and women. Expected wages are capturing the selectivity-adjusted remuneration to personal characteristics in the different sectors ($\boldsymbol{X}\hat{\beta}$). Since $\hat{w}_{ij}$ are free of selection bias, they are valid for the female and male population, respectively; i.e. $\hat{w}_{ij}$ is the wage that individual i would earn if she decided to sell her labour endowment in sector j regardless of her present labour status and occupation. Notice that the difference between average observed hourly log wages (figure 3) and the average expected ones

reforms using household data combined with price changes in certain commodities. In a forthcoming paper we combine the microsimulation model outlined here with an explicit trade-price-wages econometric estimation to quantify the isolated impact of tariff reduction as a result of NAFTA. Preliminary results show that, in the case of Mexico, tariff reduction under NAFTA is far from being the main determinant of the changes occurring in the tradable sector after 1994.

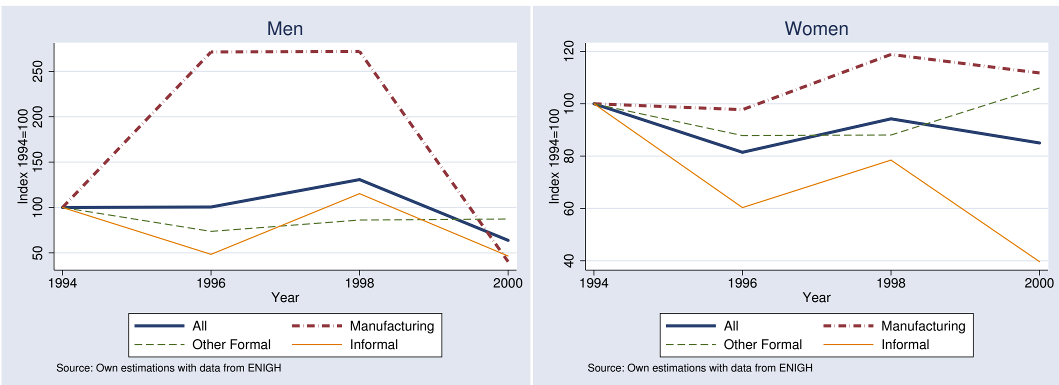
[18]See De Hoyos (2005a) for details.

[19]The results of equations 3 to 6 are shown in Appendix A, however due to space limitation we do not show the estimates of the multinomial logit first-stage estimations, these are available from the author upon request.

(Figure 4) is attributable to the selection component of the wage equation: $F(z_i\gamma_s)$.

In general, apart from the changes occurring in the informal sector, we can say that the market value of personal characteristics did not decrease (it even increased in the manufacturing sector) as much as real wages after the 1994-95 negative shock. This evidence suggests that during a negative income shock the better a worker is endowed with $\boldsymbol{X}$, the lower the impact of the shock. In the case of post NAFTA Mexico, this is particularly true for workers in the tradable (manufacturing) sector. The market value of male personal characteristics in the manufacturing sector were 2.5 times higher after the 1994-95 crisis. This is a quite powerful result specially if we consider that expected wages in the non-tradable sectors experienced a negative shock. Tradable's positive impact is not as sharp in the female labour market, however average $\hat{w}_i$ still shows a performance well above the average one where $\hat{w}_i$ remained constant between 1994 and 1996 when the change in other non-tradable sectors was negative. Between 1996 and 1998, expected wages for men in the tradable sector did not change whilst those for women showed an increase of 20 per cent. Between 1998 and 2000, once the effect of the 1994-95 crisis were fading away, expected wages in the tradeable and informal sectors decreased, especially those of men in the tradable sector.

Figure 4: Change in Average Expected Log Wages



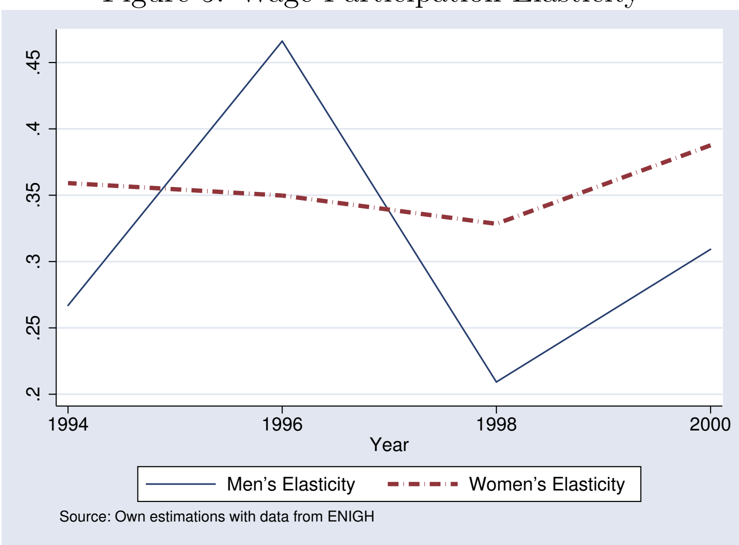
The results presented in Appendix A.1 permit a closer inspection of the sources behind the opposing changes in average $\hat{w}_{ij}$ between tradable and non-tradable sectors. From Table 1 in Appendix A.1 we can see that the sharp increase in men's expected wages in the tradable sector is explain by a shift in the equation's intercept and to a lesser extend to an increase in the wage premium for higher education between 1994 and 1996. On the other hand, the reduction in expected wages for men working in formal non-tradable sectors is also explained by shifts in the intercepts. In both labour segments (male and female) the returns associated with formal years of schooling in the tradable sector decreased, however the premium for higher education increased between 1994 and 1996. After 1996, changes in men's expected wages are explained by the combination of shifts in the intercept and increases in the wage premium for workers located in the north of Mexico. Since the parameters estimated in all wage equations are free of selection bias, we can interpret them as sector-specific 'treatment' effects. Therefore an overall positive shift in the tradable sector wage function combined with a negative change in the non-tradable sector, is evidence of a tradable sector-specific positive wage effect.

Regarding women's expected wages, our results show that the main factor behind the post-1996 tradeable sector $\hat{w}_i$ outstanding performance is the increase in the wage premium associated with female workers located in the north of Mexico. Given that most of the post-NAFTA exporting manufacturing firms are located in the north of Mexico, a positive wage premium associated with workers in this region points towards a trade-induced positive effect upon real expected wages. This result as well as those ones found in the male labour market, suggest a trade-specific positive wage effect.

The changes in $\hat{w}_{ij}$ documented in Figure 4 can have a significant effect upon labour participation ($\boldsymbol{L}$) and occupation among the different sectors. Participation/occupation decisions will change as a results of changes in $\hat{w}_{ij}$ as long as the estimated wage-participation elasticity is different from zero. In

Appendix A.2 we show the estimation results for equation 6.[20] The parameter capturing the wage-participation elasticity is positive and significantly different from zero in all years both for men and women. Following the marginal effect formulae for the multinomial logit, the wage-participation elasticity can be easily computed based on the estimated wage-participation parameter. The results are shown in Figure 5. We can see that apart from 1996 (a year when there was a large negative income shock) the percentage increases in female participation as a result of an increase in expected wages tend to be larger than that for men. A 1 per cent increase in expected wages will increase female labour participation rate 0.35 per cent on average, whereas male increase in participation as a result of the same change would be around 0.25 per cent (excluding year 1996). These results help us explain the changes in labour supply documented in Section 3.1. Since female wage-participation elasticity is larger than that for males, changes in female labour demand will have a larger impact upon employment (participation and hours worked) than in real hourly wages.

Figure 5: Wage-Participation Elasticity



[20]A detailed discussion on the participation/occupation equation results for women can be found in De Hoyos (2005b)

To summarize, we have shown that contrary to what one would expect, $\hat{w}_i$ in the tradable sector did not decrease during the crisis years of 1994-96. On the other hand, $\hat{w}_i$ in non-tradable sectors show the expected 1994-96 negative shock and the post 1996 recovery (for the formal non-tradable sectors). The difference in $\hat{w}_i$ between these two sectors, most likely, can be attributable to trade effects. The estimated wage-participation elasticity is positive and, a part from 1996, larger for women than for men.

4.1 Interpretation and robustness

Based on our empirical results we have made an argument supporting the hypothesis that most of the post-1994 sectoral redistribution is actually capturing the effects of trade. The positive and temporary 'treatment' effect upon the tradable sector can be attributable to two main factors: trade policy (NAFTA) and the peso devaluation of 1995. A sensible criticism to these results is that they are, to some extents, driven by changes in one single parameter in the wage equation, namely, the intercept which can be simply capturing *noise* in the data or be dependent upon the econometric specification. In this section we will elaborate on these important points.

From Table 1 in Appendix A.1 we can see that, as a matter of fact, many of the intercepts of the wage equations in the manufacturing sector are not statistically different from zero. Therefore our main result (increases in tradable's sector $\hat{w}_i$) might be simply capturing noise rather than a legitimum change in labour market conditions. However, more important that their absolute value, what determines the presence of a trade-induced effect are the changes in the value of the parameters in the tradable sector *relative* to the changes in the non-tradable sector. Between 1994 and 1996 the change in intercept in the formal non-tradable sectors was negative (the difference in intercepts is statistically different from zero at the 99 per cent level) while the change in the intercept for the manufacturing sector is positive and significant at the 90 per cent level of confidence.[21] Hence, *ceteris paribus*, workers in the non-tradable sector will experience an exogenous increase in the wage they expect to earn if they decide to move to the tradable sector regardless of their endowment $\boldsymbol{X}$. The other important variable driving our results is the change in the dummy variable measuring wage differentials between labourers in the tradable sectors located in the north of Mexico compared with non-tradable sectors and other regions. The difference in this parameters, both for male and female, between 1996 and 1998, are statistically different from zero. All these results support the hypothesis of a trade-induced positive shift in labour demand during a period of a large devaluation combined with a wider exporting window opened by NAFTA.

A temporary positive shock on returns to personal characteristics in the tradable sector is a result also found in a recent paper by Verhoogen (2004). Using firm-level data, the author develops and tests a model where south to north exporting products enjoy a higher quality than those ones produced for the domestic market. After an exchange rate shock, the demand for high quality products increases (exports) therefore southern exporting firms increase their labour demand, particularly the one for skilled workers. These changes in relative demand, causes an increase in the skilled-unskilled wage-ratio. After the exchange rate shock vanishes, domestic market production recovers and demand for skills is reduced, hence returns to personal characteristics and the wage ratio returns to its pre-crisis level. This pattern in returns to personal characteristics is supported by our results using household survey data.

A second point that might give rise to criticism about our results is how dependent they are to different methods to control for selectivity. To address this concern, using the conditional probabilities of participation estimated

[21]Given the negative change in the non-tradable wage equation intercept, even a constant intercept in the tradable sector wage equation will be enough to conclude that the performance of $\hat{w}_i$ in the tradable sector was *relatively* better than the non-tradable sector one.

from the multinomial logit, we control for selectivity using two alternative methodologies described in Durbin and McFadden (1984) and Bourguignon, Fournier and Gurgand (2004). Using whichever of these two selectivity-adjustment methods do not alter the general results discussed in the previous section, though the magnitude of the changes in parameters varies quite a lot across these methods. Both approaches suggest that there is a manufacturing sector 'treatment' effect shifting the wage equation parameters in favour of the tradable sector after the combination of NAFTA and the peso devaluation, particularly between years 1996 and 1998. However the estimated parameters, specially the intercept, are very volatile under these two alternative methods. Finally, we carried out a fourth experiment where selection bias was controlled à la Heckman (1979) using a probit model in the first-stage estimation; the trade versus non-trade divergence in $\hat{w}_i$ was still present with the estimated parameters being much more stable.

A further concern about the interpretation of our results could lie in the effects captured by changes in returns to personal characteristics ($\hat{\beta}$) in the tradable sector. Although this paper focuses on the welfare impact of increases in trade volumes (regardless of what triggers it) the results will not be very useful for trade *policy* implications if we are *only* capturing the effects of the devaluation. To make a case against this extreme interpretation, we compare the performance of trade after the 1994-95 peso crisis and NAFTA with an episode with a large currency crisis in the absence of a trade agreement. The period between years 1982 and 1983 represent a scenario with devaluation but without a trade agreement. Between 1982 and 1983 the Mexican peso suffered a devaluation of 100 per cent, however at that time the Mexican economy was a relatively closed one with average tariffs above 25 per cent and with 90 per cent of the tradable products subject to trade licensing. Openness (measured as the total trade flows as a percentage of GDP) increased only 2 percentage points between 1982 and 1983 (see Figure 2) as opposed to the 20 per cent increase in openness observed after a devaluation of 80 per cent in 1994. Therefore we can say that the post-1994 boom in export volumes is explained by the devaluation of the Mexican peso in the *presence* of a trade agreement. In the remainder of the paper, we will interpret the changes in $\hat{\beta}$ in the manufacturing sector as being the outcome of increasing trade volumes, which were triggered, in turn, by the combination of trade policy and the peso devaluation.

A final caveat must be stated. The rest of the paper tries to quantify the welfare effects of the changes in $\hat{w}_{ij}$ just documented. As in any other econometric analysis, robustness in the quantitative aspect of the parameters is hardly achieved. Although we showed that the qualitative changes in $\hat{w}_{ij}$ are robust to several selectivity-correction methods, we cannot say the same for the *value* of the parameters. Therefore the results that we present in the subsequent sections have to be taken *only* as first approximations to the quantitative welfare effects of trade-induced changes in $\hat{w}_{ij}$.

5 Microsimulation analysis

The changes in $\hat{w}_{ij}$ documented so far (Figure 4) are not entirely explained by changes in parameters, Ω_w, they also capture changes in endowments, $\boldsymbol{X}$, and their distribution. To be able to quantify the isolated welfare impact of trade-induced changes in wage equation parameters, Ω_w^T, in this section we will undertake a microsimulation analysis like the one described in Section 2.4.

To capture the micro dynamics of changes in manufacturing sector 'prices' of personal characteristics, we undertake three separate simulations. Taking 1994 as our base year we 'import' the estimated tradable sector's wage equation parameters Ω_w^T for years 1996, 1998, and 2000. Each of these simulations can be interpreted as the *ceteris paribus* income effect of $\Delta\Omega_w^T$ between 1994 and t'. Once Ω_w^T had been 'imported' and a new set of simulated wages had been computed, we will follow the methodology outlined in Section 2.4 to compute a set of simulated household incomes. Each of these simulations is answering the question: *how would household incomes in 1994 have look like had the returns to personal characteristics in the tradable sector been the same as the ones observed in t'?*[22]

5.1 First-order welfare effect

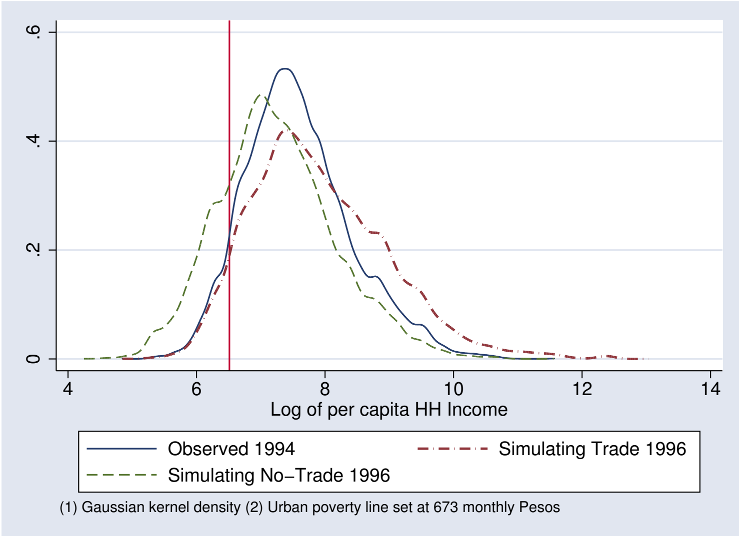
Given the great differences shown by $\hat{w}_{ij}$ between the pre- and post-crises periods, we separate the discussion of our simulations into those covering the years 1994-1996 and 1996-2000. In Figure 6 we show the log of per capita household income densities of two different simulations using 1994 as the base year and 'importing' the estimated parameters for year 1996. In the simulation called 'simulating trade', we import only the estimated parameters in the tradable sector for year 1996 keeping non-tradeable parameters and all sector covariates and unobservables fixed. In a second simulation we import only the estimated parameters for the non-tradable sector leaving those in the tradable sector fixed. 'Simulating trade' is creating a hypothetical scenario where all the post-NAFTA/devaluation benefits of trade are occurring without the costs impinged upon the non-tradable sectors. This counterfactual can be interpreted as a hypothetical economy with all the benefits of trade expansion without the costs of the devaluation. 'Simulating no-trade' creates a hypothetical economy where the crisis negative shock taking place in the non-tradable (captured by the shifts in $\hat{\beta}$) is occurring without the benefits experienced by the tradable sector (Ω_w^T remains constant). We can think of this second counterfactual as simulating what would the income density had been if the peso crisis had occurred in the absence of NAFTA.

As we can see from Figure 6, everything else being equal, the changes in returns to personal characteristics in the tradable sector had a positive effect upon household per capita incomes regardless of their position in the distribution (positive growth effect). However since the average worker in the

[22] Conversely, the same simulation can be interpreted as creating a counterfactual household income for year t' where everything but Ω_w^T remained constant.

manufacturing sector tends to be located at the middle part of the density, trade's positive effect was quite moderate in the lower income cohorts (negative redistribution effect). This biased effect is reflected in the low pro-poor impact of changes in the tradable sector's wage parameters.

Figure 6: Simulated Per-Capita Household Income Effects



In Table 2 we show the observed and simulated urban poverty and inequality indexes for the years 1994 to 2000. For year 1994 there is no simulated values since we always take this year as the base one importing the parameters of subsequent years. We show the results of the two simulations, i.e. a scenario with and without tradable's sector changes in Ω_w^T. Had the only change in the economy between 1994 and 1996 been the returns to personal characteristics in the tradable sector, poverty would have been reduced from an initial headcount ratio of 7.3 per cent to a final one of 6.2 per cent. Conversely, if the only change allowed was the one experienced by the wage parameters in the non-tradable sectors (simulating crisis without trade), then poverty would have increased from 7.3 per cent in 1994 to 20.7 per cent in 1996, with a poverty headcount ratio 2 percentage points above the observed level. In other words, had NAFTA not been enacted, we would have observed an even larger increase in poverty after the peso crisis of 1994-95. The actual change in poverty between those years was indeed between the simulated trade and no-trade effects. Regarding redistribution, changes in parameters—both in the tradable and non-tradable sectors—had an adverse redistribution effect. However, the increase in inequality when simulating trade effects is much larger (an increase of 14 Gini points) than the one simulating the no-trade effects (three Gini points). This is totally explained by the reduction in the mass around the mean together with an increase of the upper tail in the density capturing the effects of trade (figure 6). Hence the increase in inequality is not explained by reductions in the income of the poor but by increases in incomes of upper cohorts.[23]

Table 2: Simulated Income Inequality and Poverty Indexes (Urban Areas)

	1994	1996	1998	2000
Observed				
Poverty	0.073	0.183	0.142	0.092
Gini	0.493	0.483	0.484	0.473
Simulating trade				
Poverty	-	0.062	0.060	0.100
Gini	-	0.635	0.621	0.501
Simulating no-trade				
Poverty	-	0.207	0.131	0.170
Gini	-	0.522	0.497	0.511

Source and notes:

(1) Own estimations with data from ENIGH

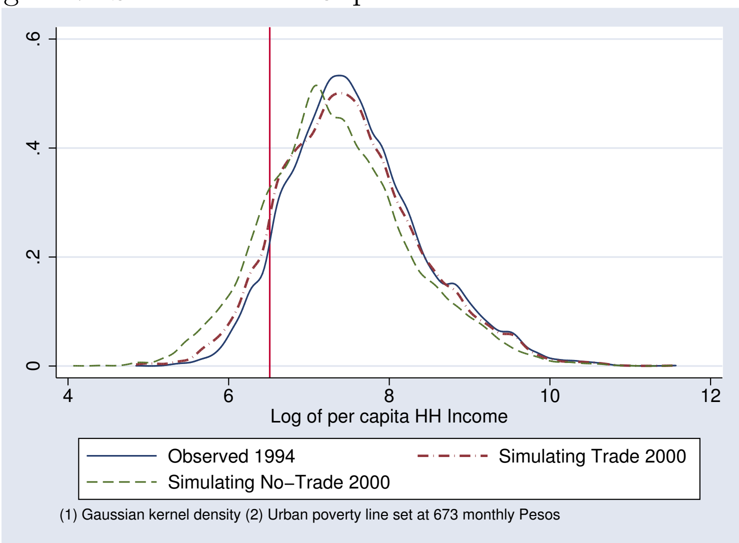
(2) The poverty index is the headcount ratio

(3) Using the urban poverty line defined by the Mexican Ministry of Social Development

[23]The increase in inequality is allowing for post-simulation re-ranking of individuals along the income density.

After 1996, the simulated poverty benefits of trade volumes tend to decrease. By 2000 the simulated isolated poverty effect of trade is adverse compared with the observed value for that same year. These results are driven by the temporary increase in tradable sector's $\hat{w}_i$ discussed in Section 4. Once $\hat{w}_i$ in the tradable sector returns to its pre-crises level (in year 2000), the positive trade effects tend to vanish. This is particularly the case for the male labour market. Nevertheless, the simulated welfare effects in the presence of trade are still preferable to those ones in the absence of it. In Figure 7 we show the results for the same type of simulation as in Figure 6 this time using the wage parameters for year 2000. Had trade liberalization not taken place (and hence the parameters of the wage equation in the tradable sector didn't change), the poverty headcount ratio would have been 17 per cent compared with an index of 10 per cent simulated under the trade liberalization scenario.

Figure 7: Simulated Per-Capita Household Income Effects



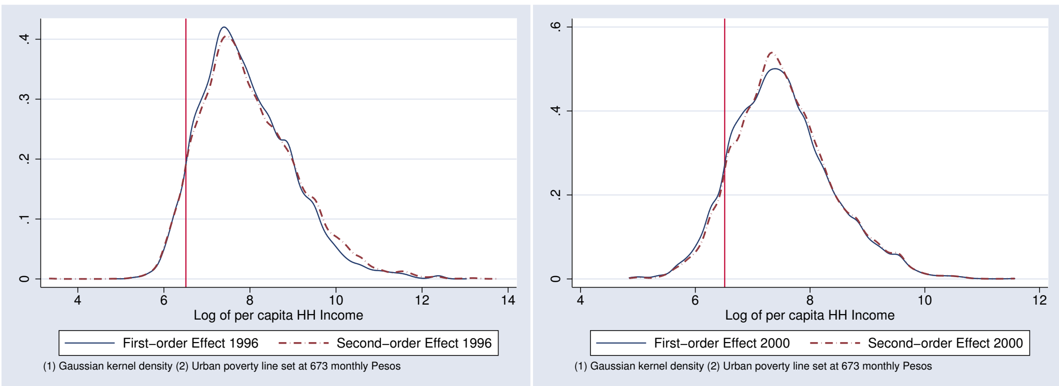
In this section we have shown the welfare impact of the asymmetric changes in $\hat{w}_{ij}$ discussed in Section 4. As one would have expected a *ceteris paribus* increase in tradable sector's $\hat{w}_i$ has a positive welfare effect, increasing average income and reducing poverty. Given the position of tradable sector workers in the urban income density, an increase in their remunerations has an adverse distributive impact. Our simulations also illustrated that had the peso crisis occurred in the absence of NAFTA, the poverty headcount ratio would have been 2 percentage points above the 1996 observed level. The positive welfare effects occurring via changes in the tradable sector vanish by year 2000. This last result suggests that although the devaluation of the Mexican peso was ameliorated in the presence of a trade reform, NAFTA, by itself, does not represent a long-term development policy.

5.2 Second-order welfare effect

So far we had discussed the changes in household income brought about by changes in returns to personal characteristics without allowing agents to re-optimize given the new set of 'prices'. In this section we will explore the second-order household income effects of changes in Ω_w^T. As we saw in Section 4, the post-NAFTA/crises changes in $\hat{w}_{ij}$ favoured the tradable sector. If labour markets are not perfectly segmented we would expect labour movements out of the non-tradable sector into the tradable one. Additionally, overall labour participation could have increased after the macro shock.

To account for the changes in participation and occupation decisions given the simulated set of $\hat{w}_{ij}$ we use the wage-participation elasticity results presented in Section 4. Substituting the simulated expected wages into equation (6) we compute a new set of participation probabilities. As we already mentioned, an agent's 'utility' maximizing decision (or the most probable outcome) could be bounded by demand-side restrictions. To take this restriction into account, we construct an *excess labour supply* by comparing the *simulated* utility maximizing decisions with the *observed* outcomes for each sector in each point in time. For example, simulating the *ceteris paribus* change in participation/occupation as a result of changes in $\hat{w}_{ij}$ between 1994 and 1996 we find out that, in the absence of demand-side restrictions, participation in the tradable sector would have passed from 12 per cent to 26 per cent of the total working age population. This simulated increase in tradable sector participation contrasts with the observed one which passed from 12 per cent in 1994 to 14 per cent in 1996. If we allow all those workers 'willing' to work in the tradable sector (26 per cent of them with the 1996 parameters) to do so, we will be ignoring labour demand restrictions and hence overestimating trade's positive second-order effects. Instead of using unrestricted labour movements, we constrain the excess labour supply (i.e. when even there is a net increase in participation) to be no larger than the observed increase. Following or example, when we simulate the second order effects of changes in Ω_w^T between 1994 and 1996, workers are allowed to enter the tradable sector up to a point where 14 per cent of the total population within working age is employed in that sector. We 'select' the workers that enter into each sector based on their 'willingness' (probability) to do so, therefore workers with higher utility (probability) of entering the sector with an excess labour supply will enter first. On the other hand, a simulated *negative* excess labour supply is not bounded by demand restrictions and therefore the full effect is allowed to pass through.

Figure 8: Simulated Second-Order Effect



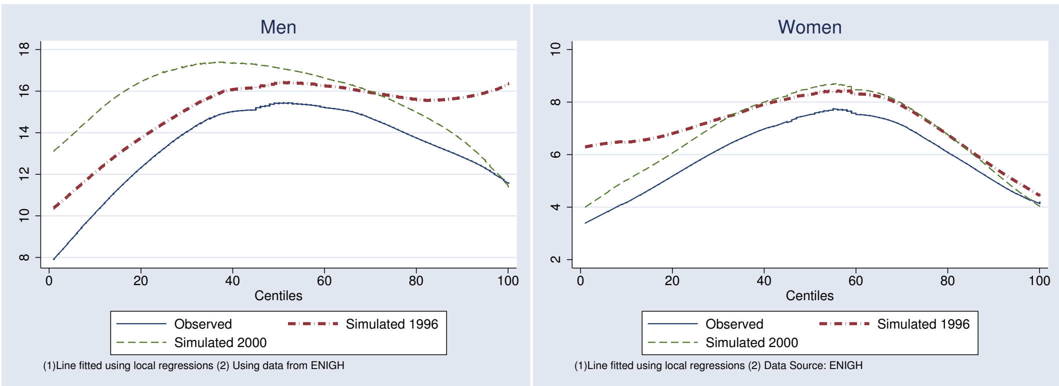
The second-order income effect of changes in Ω_w^T are shown in Figure 8. Following Section 5.1 we show two different simulations, one of them using Ω_w^T for 1996, and a second one with the estimated parameters for 2000. This time we only compute the second order effects of changes in tradable sector parameters *ceteris paribus* without showing the second order effects of changes in non-tradable parameters. As we can see from Figure 8, the second-order income effects are rather small (given labour demand constraints) though still positive.[24] The positive second-order effect is more evident when we use the simulated wages with the estimated parameters for 2000; the mass around the mean increases and this is compensated by a lower tail decrease.

Given the microeconomic nature of our methodology, we can have a closer look at the distributive impact brought about by the change in an agent's optimizing decision. Useful information about the inequality impact caused by a sectoral redistribution can be obtained by knowing the socioeconomic characteristics of the agents working in the each sector. We would expect a worsened distribution if most of the workers in the growing tradeable sector belong to relatively better off households. In Figure 9 we show non-parametric regression lines with the number of workers in each centile in 1994 and for the 1996 and 2000 simulated second order effect (without re-ranking). We can see that in 1994 the majority of the workers in the tradable sector belonged to middle class households (between the 50th and 60th centile). In the case of men, the 1996 simulated change in expected wages in the tradable sector increased participation in all income cohorts (the simulation line is above the observed one in all centiles) but this was particularly true for workers belonging to upper income cohorts, i.e. workers enjoying higher skill endowments. The labour composition in the case of women changed in a way that more unskilled workers—belonging to lower income cohorts—entered the tradable sector after the combination of NAFTA and the crisis. Hence, although the second-order income effect of changes in tradable sector parameters was positive, it was disequalizing in the case of men and equalizing in the case of

[24]Following economic theory and the methodology used in this study, it is impossible to have a negative second-order welfare effect. Given a new set of prices in the economy, the agents will always be better off if they are allowed to re-optimize their consumption and labour allocation decisions. Regarding household income, the only way to have a negative second order income effect is if there is a strong and negative substitution effect making workers better off by abandoning the labour market.

women between 1994 and 1996. The story is completely different for the simulated changes using the parameters for 2000. The results presented in the right hand side of Figure 9 confirm our previous findings: the second order effect for 2000 had an equalizing income effect. Taking the estimated parameters for 2000, the number of simulated workers whose households belonged to lower income cohorts increased, indeed the household of the typical worker in the tradable sector was located around the 35th and 45th income centile compared with the 50th to 60th centile observed in 1994.

Figure 9: Distribution of Workers in each Centile



In this section we have shown how the micro model outlined in Section 2 can be used to uncover second-order household income effects of changes in prices—in our case returns to personal characteristics. We showed that although demand-constraint second-order effects tend to be small, the impact is always positive. Our findings suggest that there are important distributional impacts emanating from the changes in participation and occupation. In particular, the labour participation changes occurring as a consequence of changes in returns to personal characteristics in the tradable sector, had an adverse distributional impact between 1994 and 1996, increasing the relative participation of skilled workers. By the year 2000 the effect was exactly the opposite, with a change in in the skill-mix favouring unskilled labourers.

6 Conclusion

This paper is motivated by the growing concern on the microeconomic impact of policy decisions taken at the macro level. We depart from the changes in income densities which summarizes all welfare changes taking place between two points in time. With the use of economic theory and microeconometric techniques we decompose the changes in densities (and therefore any welfare index) into changes in parameters, covariates and unobservables. Our model contributes to the existing literature by creating an explicit relationship between expected wages and labour participation. This last feature allows us to quantify the second-order welfare effects of policy-driven changes in expected wages.

Our methodology is used to explore the welfare impact of the Mexican expansion in exports after the Peso devaluation and the enactment of NAFTA. We found robust positive changes in the returns to personal characteristics in the tradable sector between 1994 and 1998. Although expected wages in the tradable sector increased for all workers regardless of their personal characteristics (positive shift in the intercept), those workers with higher skills and/or located in the North of Mexico, experienced an even larger positive effect. The increase in higher education premium had as a consequence a deterioration in household income distribution. Our results are robust to several forms of selectivity-correction methods and they are supported by the findings of recent post NAFTA firm behaviour studies.

Using microsimulation techniques, we quantify the *ceteris paribus* welfare effects of increases in trade volumes. In a hypothetical economy where devaluation is taking place in the absence of NAFTA, i.e. all the costs of the devaluation upon the non-tradable sector are occurring while the benefits of an expanding tradeable sector are not, poverty would have increased 2 percentage points above the observed 1996 level. Nevertheless, the isolated impact of a change in tradable sector's parameters had an adverse distributive impact increasing the Gini in 13 points. By year 2000 the positive tradable sector 'treatment' effect vanished, with returns to personal characteristics converging to the levels observed in the non-tradable sectors.

The paper contributes to the growing microsimulation literature by quantifying in an explicit way the second-order income effects brought about by changes in expected wages. We estimate a wage-participation elasticity which is then used to quantify the change in participation and occupation caused by changes in expected wages in the different sectors. After the peso/NAFTA shock, relatively skilled male workers entered the tradable sector while the oppositive happened in the female labour market where the tradable sector was absorbing relatively unskilled labourers. These changes had an adverse effect upon distribution, although the overall second-order income effect of the isolated trade-induced changes in expected wages was positive.

Although NAFTA 'cushioned' the adverse effects of the peso devaluation, proving to be the right policy decision at that time, as soon as the peso recovered its value (between years 1998 and 2000) the growing pace of Mexican manufacturing exports and the wage premium associated with it decreased. Therefore the isolated positive welfare effects caused by trade expansion disappear between 1998 and 2000. Our findings suggest that NAFTA, by itself and given the present economic conditions in Mexico, does not represent a long-term development policy. The episode 1994-98 showed the great benefits of having a trade agreement combined with a highly competitive industrial sector. At that time, competitiveness came exogenously in the form of a currency crisis, however long-term sustainable competitiveness should come from an increase in productivity which is exactly what Mexican industrial policy should aim for.

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A Model Results

A.1 Selectivity-Adjusted Wages

Table 1: Wage Functions for the Tradable Sector

	1994	1996	1998	2000
Men				
$Schooling$	0.150***	0.111***	0.125***	0.144***
$Schooling * I(Ys > 11)$	-0.019	0.035**	0.019**	-0.026
$Experience$	0.075***	0.079***	0.076***	0.077***
$Experience^2$	-0.001***	-0.001***	-0.001***	-0.002**
$North$	0.061	0.007	0.173**	0.588*
$Pr(manufacture)^{\dagger}$	1.129**	-0.793	-0.693	1.76
$Intercept$	-0.607	1.649	1.500*	-1.508
R^2	0.469	0.432	0.427	0.446
N	1271	1513	1107	968
Women				
$Schooling$	0.138***	0.105***	0.149***	0.111***
$Schooling * I(Ys > 11)$	-0.004	0.022	0.003	0
$Experience$	0.068***	0.042***	0.071***	0.031***
$Experience^2$	-0.001***	-0.001**	-0.001***	0
$North$	0.074	0.141	0.269***	0.333***
$Pr(manufacture)^{\dagger}$	0.275	0.142	-0.076	0.105
$Intercept$	0.355	0.579*	0.295	0.801**
R^2	0.271	0.248	0.28	0.237
N	491	609	511	428

Notes:

(1) *,**,***, significant at the 10%, 5% and 1% level respectively

(2) Bootstrap standard errors with 200 replications

(3) Data source: ENIGH 1994, 1996, 1998 and 2000

(4) $Pr(\cdot)^{\dagger}$ are computed following Lee (1983)

Table 2: Wage Functions for Non-tradable Formal Sectors

	1994	1996	1998	2000
Men				
$Schooling$	0.109***	0.109***	0.097***	0.088***
$Schooling * I(Ys > 11)$	0.016**	0.021***	0.024***	0.021**
$Experience$	0.059***	0.065***	0.055***	0.053***
$Experience^2$	-0.001***	-0.001***	-0.001***	-0.001***
$North$	0.055	0.083*	0.180***	0.137*
$Pr(other\ earner)^{\dagger}$	-0.611*	0.09	-0.432	-0.257
$Intercept$	1.568***	0.663**	1.228***	1.364***
R^2	0.475	0.416	0.43	0.397
N	3838	4155	3293	2994
Women				
$Schooling$	0.148***	0.136***	0.143***	0.131***
$Schooling * I(Ys > 11)$	0.020***	0.014***	0.021***	0.011*
$Experience$	0.077***	0.069***	0.060***	0.057***
$Experience^2$	-0.001***	-0.001***	-0.001***	-0.001***
$North$	-0.046	0.004	0.083*	0.105**
$Pr(other\ earner)^{\dagger}$	0.290***	0.245***	0.243**	0.065
$Intercept$	0.337*	0.21	0.059	0.637***
R^2	0.469	0.376	0.411	0.403
N	2213	2393	1950	1850

Notes:

(1) *,**,***, significant at the 10%, 5% and 1% level respectively

(2) Bootstrap standard errors with 200 replications

(3) Data source: ENIGH 1994, 1996, 1998 and 2000

(4) $Pr(\cdot)^{\dagger}$ are computed following Lee (1983)

Table 3: Wage Functions for Non-tradable Informal Sector

	1994	1996	1998	2000
Men				
$Schooling$	0.036	0.069***	0.061***	0.089***
$Schooling * I(Ys > 11)$	0.033***	0.017	0.011	-0.011
$Experience$	0.046*	0.108***	0.042*	0.080***
$Experience^2$	-0.001*	-0.002***	-0.001**	-0.001**
$North$	0.068	0.063	0.082	0.006
$Pr(informal)^{\dagger}$	0.141	0.680*	-0.354	0.897*
$Intercept$	1.783**	-0.59	2.112**	-0.556
R^2	0.114	0.171	0.107	0.215
N	909	1061	788	651
Women				
$Schooling$	0.081***	0.064***	0.052**	0.037
$Schooling * I(Ys > 11)$	0.013	0.004	0.034	0.026
$Experience$	0.023	0.046***	0.033	0.063**
$Experience^2$	0	-0.001**	0	-0.001*
$North$	-0.124	0.034	-0.076	-0.096
$Pr(informal)^{\dagger}$	0.062	0.364	0.143	0.701**
$Intercept$	1.368**	0.272	0.902	-0.23
R^2	0.053	0.063	0.053	0.084
N	620	857	663	581

Notes:

(1) *,**,***, significant at the 10%, 5% and 1% level respectively

(2) Bootstrap standard errors with 200 replications

(3) Data source: ENIGH 1994, 1996, 1998 and 2000

(4) $Pr(\cdot)^{\dagger}$ are computed following Lee (1983)

A.2 Participation and Occupation Functions

Table 4: Men's Participation and Occupation Functions

	1994	1996	1998	2000
$\hat{w}$	1.954***	1.968***	1.560***	2.147***
$\tilde{h}$	-0.243***	-0.151***	-0.237***	-0.221***
Tradable Earner				
Intercept	-2.913***	-6.357***	-3.618***	-2.626***
HH Size	0.141***	0.092***	0.091***	0.201***
Y_m^0	-11.585***	-19.372***	-15.188***	-14.272***
$(Y_m^0)^2$	4.842***	3.270***	8.480**	10.310***
Non-tradable Earner				
Intercept	-0.738***	-1.188***	0.493***	-1.736***
HH Size	0.070***	0.032	0.047*	0.132***
Y_m^0	-10.635***	-13.920***	-12.833***	-13.974***
$(Y_m^0)^2$	4.744***	2.379***	7.947**	10.323***
Informal Sector				
HH Size	0.033	0.062**	0.083***	0.117***
Y_m^0	-14.646***	-19.068***	-19.665***	-19.152***
$(Y_m^0)^2$	6.104***	3.227***	9.473***	12.823***
R^2	0.202	0.205	0.179	0.212
N	33500	37496	28080	24592

*,**,***, significant at the 10%, 5% and 1% level respectively (with bootstrapped SE)

Table 5: Women's Participation and Occupation Functions

	1994	1996	1998	2000
$\hat{w}$	1.423***	1.614***	1.311***	1.721***
$\tilde{h}$	-0.168***	-0.126***	-0.127***	-0.115***
Tradable Earner				
$Intercept$	-1.796***	-2.688***	-2.913***	-3.819***
$Children$	-0.267***	-0.049	-0.002	0.135
H_s^a	-1.011***	-1.028***	-0.937***	-0.627***
H_d^a	-0.024	0.15	0.319**	0.730***
Y_m^0	-6.369***	-11.127***	-11.662***	-11.938***
$(Y_m^0)^2$	1.137***	1.727***	6.106***	7.133***
$Var(Y_m^0)$	0.002**	0.001	0.001**	-0.037
Non-tradable Earner				
$Intercept$	-1.002***	-1.305***	-0.640***	-2.524***
$Children$	-0.037	-0.111***	0.008	-0.063
H_s^a	-1.017***	-1.038***	-0.894***	-0.815***
H_d^a	0.049	-0.351***	-0.021	0.047
Y_m^0	-4.545***	-6.085***	-7.973***	-6.773***
$(Y_m^0)^2$	0.807***	0.916***	5.294***	3.175*
$Var(Y_m^0)$	0.002***	0.001	0.001***	0.001
Informal Sector				
$Intercept$	-	-	-	-
$Children$	-0.049	-0.028	-0.028	0.053
H_s^a	-0.495***	-0.546***	-0.500***	-0.389**
H_d^a	-1.653***	-1.221***	-1.296***	-0.755***
Y_m^0	-10.784***	-14.108***	-12.208***	-12.454***
$(Y_m^0)^2$	1.950***	2.261***	6.206***	5.063**
$Var(Y_m^0)$	0.002**	0.001	0.002***	0.002
R^2	0.389	0.363	0.326	0.345
N	38932	43392	32836	29320

*,**,***, significant at the 10%, 5% and 1% level respectively (with bootstrapped SE)